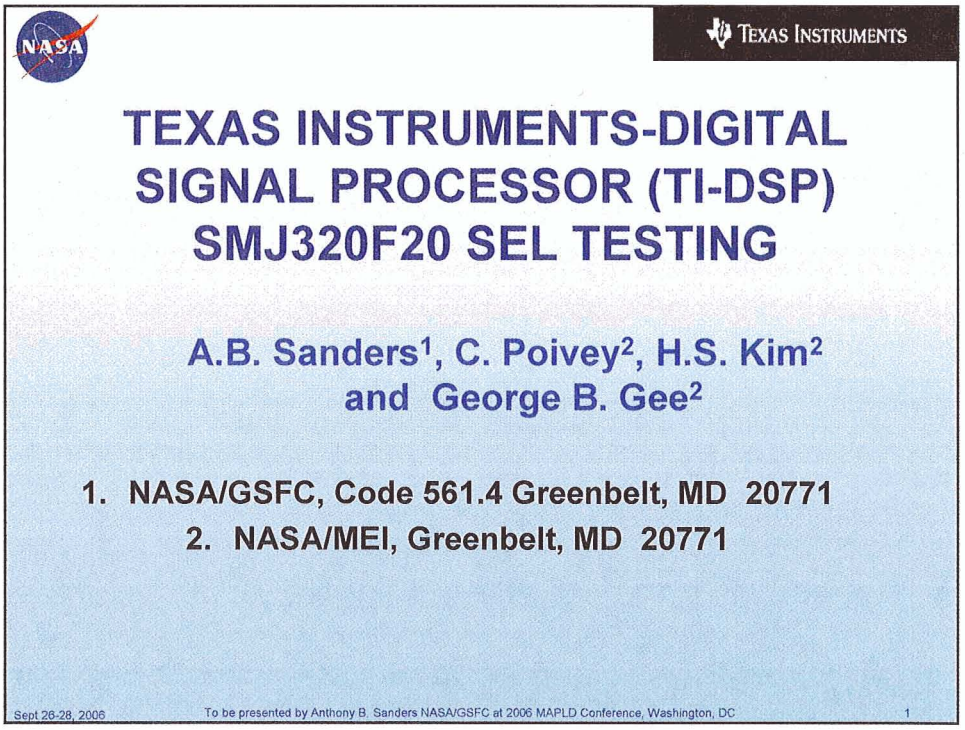
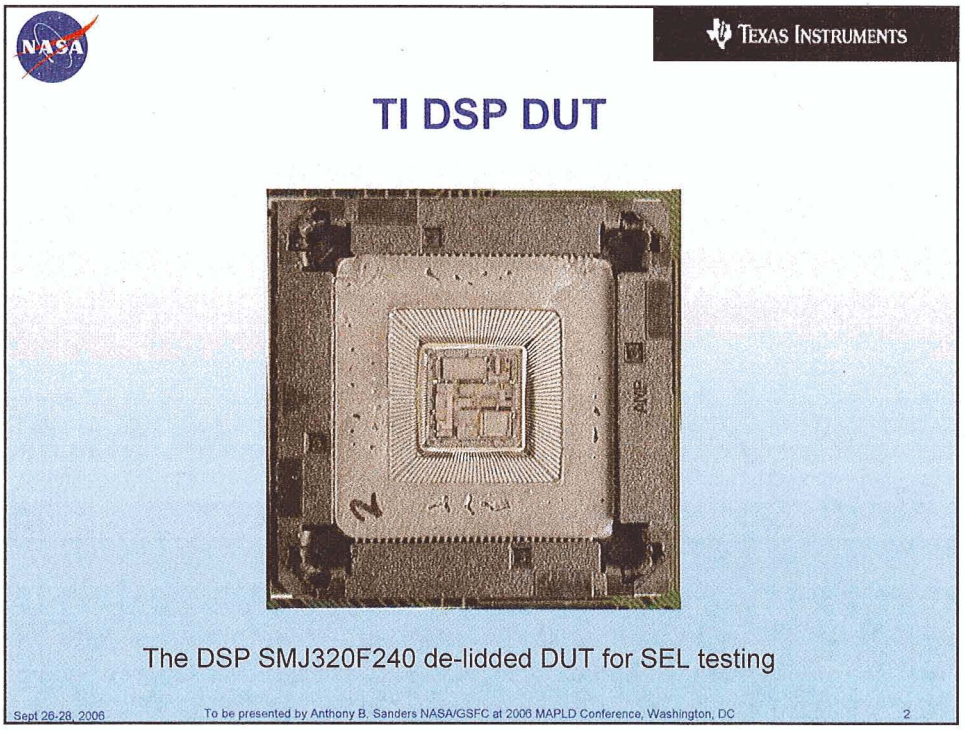

NASA
Texas Instruments
TEXAS INSTRUMENTS-DIGITAL SIGNAL PROCESSOR (TI-DSP) SMJ320F20 SEL TESTING
A.B. Sanders[1], C. Poivey[2], H.S. Kim[2] and George B. Gee[2]
1. NASA/GSFC, Code 561.4 Greenbelt, MD 20771
2. NASA/MEI, Greenbelt, MD 20771
Sept 26-28, 2006
To be presented by Anthony B. Sanders NASA/GSFC at 2006 MAPLD Conference, Washington, DC
1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TI DSP DUT
The DSP SMJ320F240 de-lidded DUT for SEL testing
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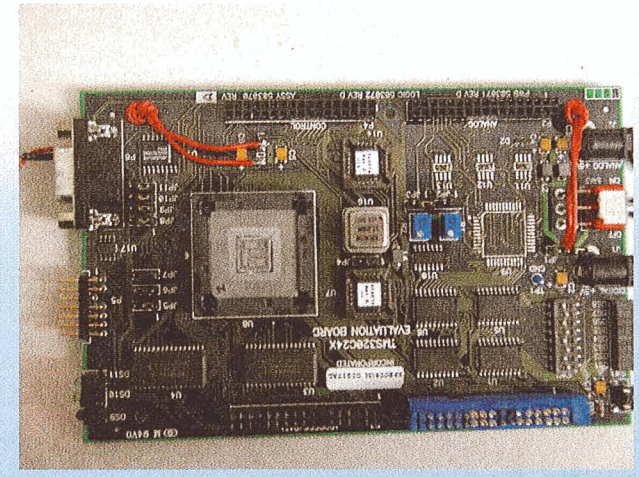
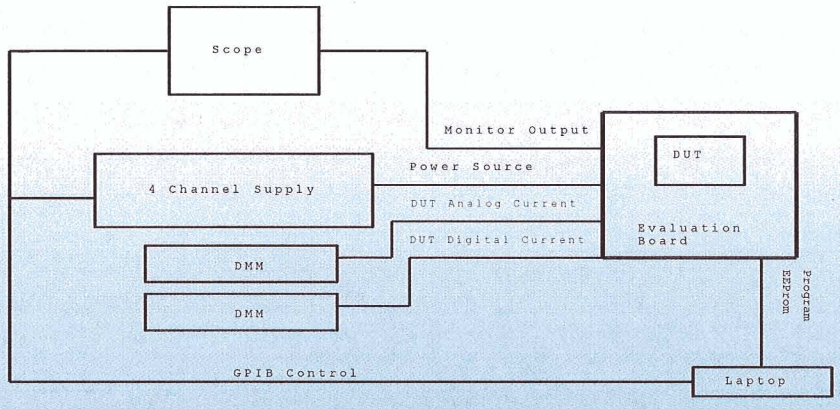
TI DSP EVALUATION BOARD



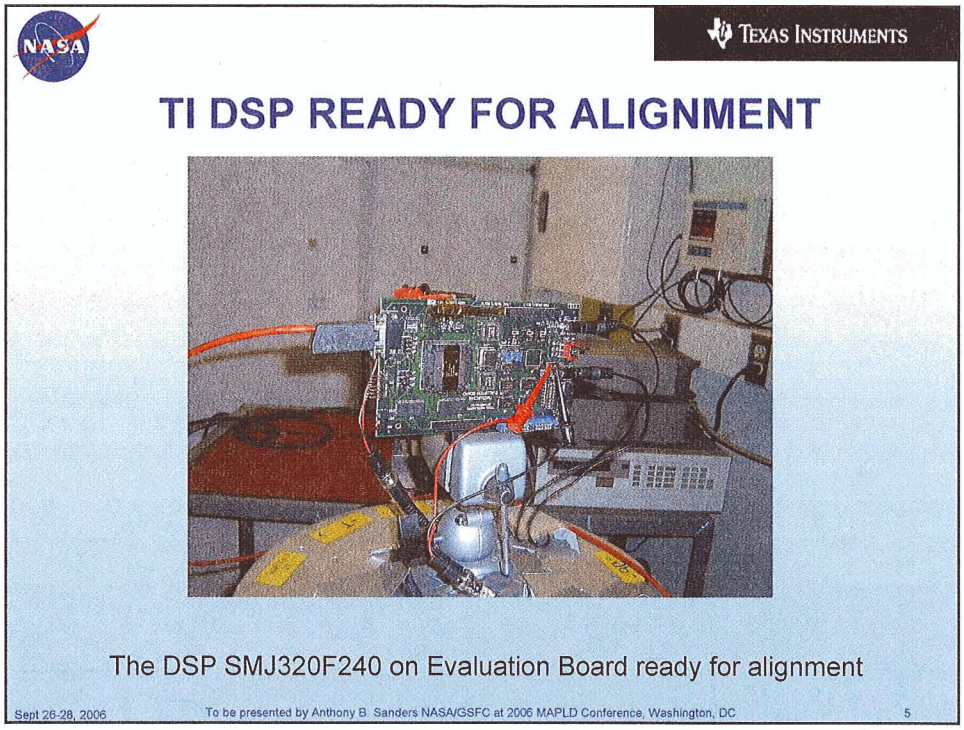
The DSP SMJ320F240 on Evaluation Board made by Spectrum Digital

TI DSP TEST BLOCK DIAGRAM



The block diagram for the DSP SMJ320F240 contains a power supply for both analog and digital voltage input of 5V each, two digital multi-meters to monitor DUT current, an oscilloscope for a status output, and a PC/laptop to program the EEPROM on the Evaluation Board and for GPIB control.

Overall Block Diagram for SEL testing of the DSP SMJ320F240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TI DSP READY FOR ALIGNMENT
The DSP SMJ320F240 on Evaluation Board ready for alignment
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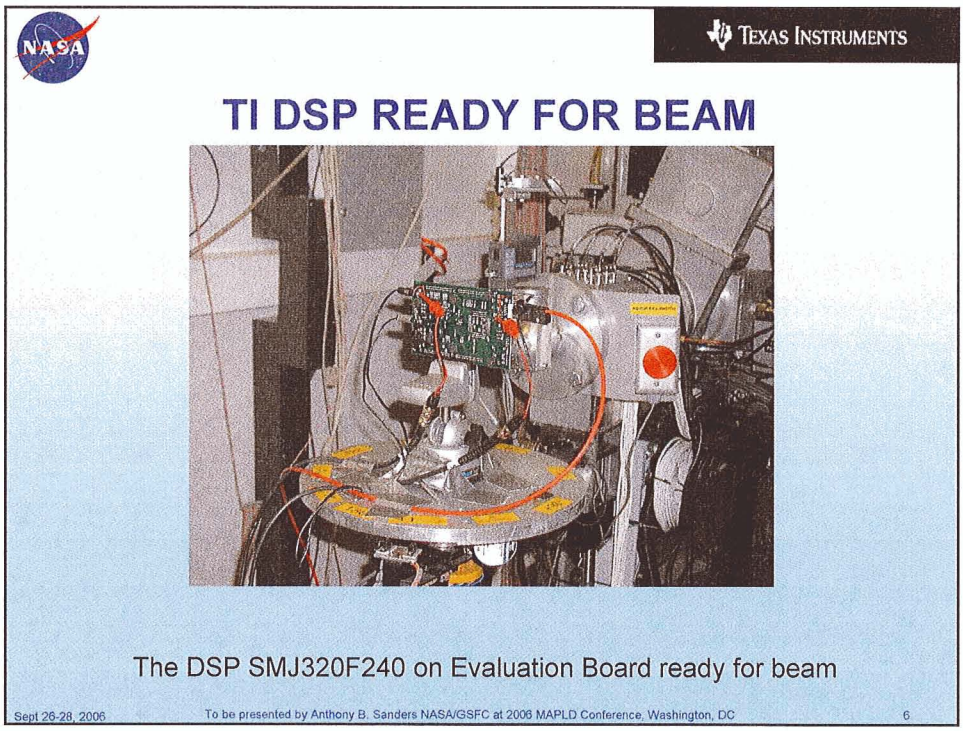
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TI DSP READY FOR BEAM
The DSP SMJ320F240 on Evaluation Board ready for beam
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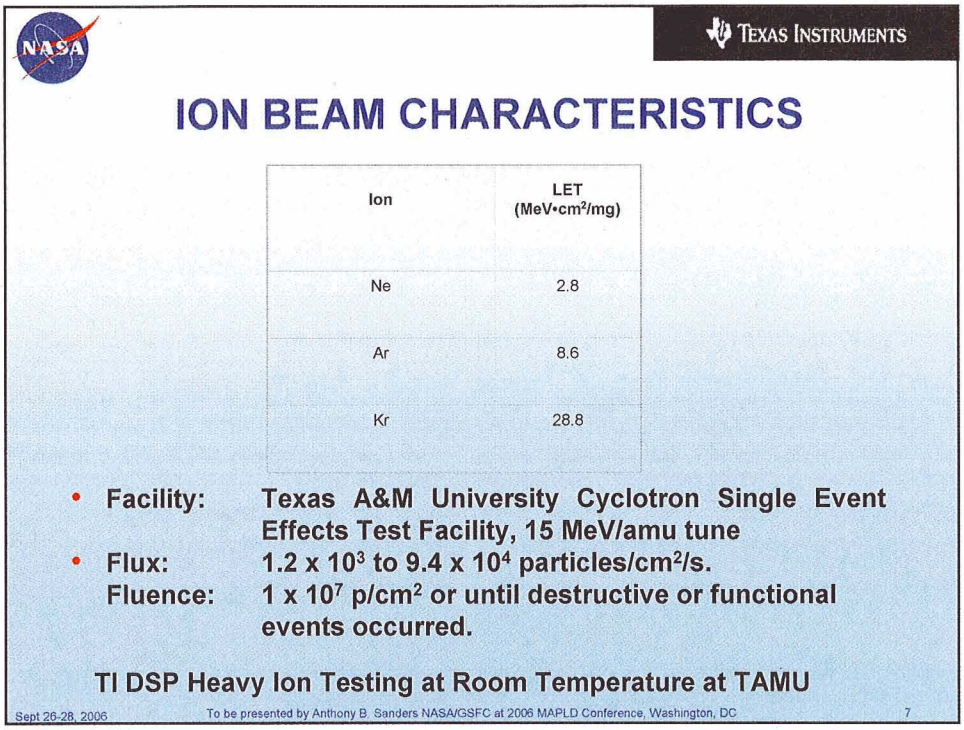
TEXAS INSTRUMENTS
ION BEAM CHARACTERISTICS
Ion
LET (MeV•cm²/mg)
Ne
2.8
Ar
8.6
Kr
28.8
• Facility: Texas A&M University Cyclotron Single Event Effects Test Facility, 15 MeV/amu tune
• Flux: 1.2 x 10³ to 9.4 x 10⁴ particles/cm²/s.
Fluence: 1 x 10⁷ p/cm² or until destructive or functional events occurred.
TI DSP Heavy Ion Testing at Room Temperature at TAMU
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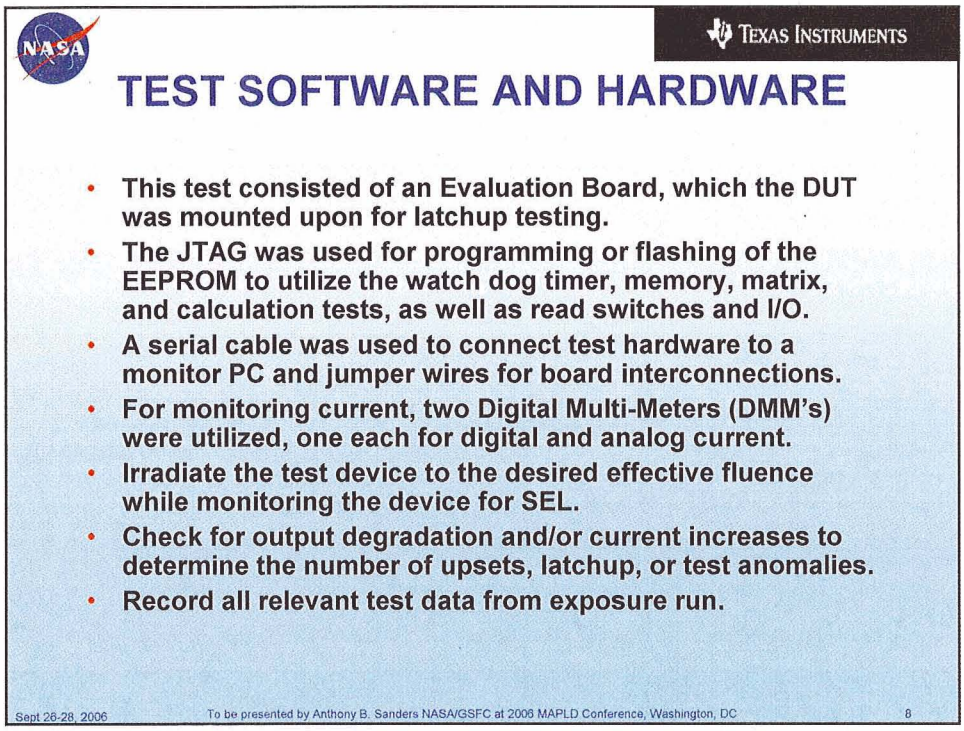
TEXAS INSTRUMENTS
TEST SOFTWARE AND HARDWARE
• This test consisted of an Evaluation Board, which the DUT was mounted upon for latchup testing.
• The JTAG was used for programming or flashing of the EEPROM to utilize the watch dog timer, memory, matrix, and calculation tests, as well as read switches and I/O.
• A serial cable was used to connect test hardware to a monitor PC and jumper wires for board interconnections.
• For monitoring current, two Digital Multi-Meters (DMM's) were utilized, one each for digital and analog current.
• Irradiate the test device to the desired effective fluence while monitoring the device for SEL.
• Check for output degradation and/or current increases to determine the number of upsets, latchup, or test anomalies.
• Record all relevant test data from exposure run.
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TEST TECHNIQUES

- Tests were performed to screen for susceptibility to SEL and measure sensitivity as a function of Linear Energy Transfer (LET) for an application specific test setup.
- The test conditions included a digital and analog input voltage of 5V each.
- Two DUT's were exposed to radiation. They were programmed via the JTAG on the Evaluation Board. An equivalent normal-incidence fluence of at least $1x10^7$ ions/cm^2 was used at each test condition unless an SEL occurred.
- A beam flux range of 1.2×10^3 to 9.4×10^4 particles/cm^2/s resulted in individual exposures between 1.05 seconds and 9 minutes and 26 seconds.

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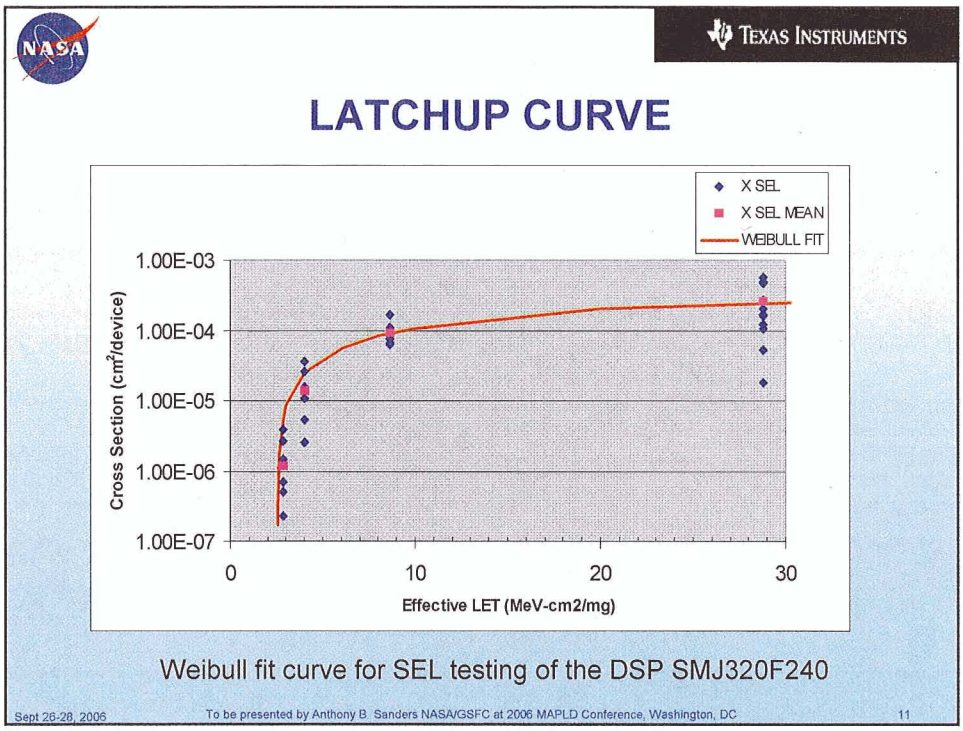
TEST TECHNIQUES CONTINUED

- The analog and digital current for the DUT were monitored separately via cables to the evaluation board.
- The DAC (MP7680JE), and the DFF (TLC2272) devices were removed from the Evaluation Board, which left the V_{CCA} only connected to the DUT and not the external circuitry.
- The digital current was monitored by placing an amp meter in series with the Inductor (L3), on the Evaluation Board.
- These monitoring techniques were needed because the DSP had to be fastened down into a socket on the Evaluation Board, thus leaving no space to attach leads to monitor current.
- Also the DUT current must be separated from the external circuitry to give accurate current measurements. If the whole Evaluation Board was monitored, the current results could be skewed by bus contention during utilization of the DSP and interfacing with the external circuitry.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LATCHUP CURVE
X SEL
X SEL MEAN
WEIBULL FIT
1.00E-03
1.00E-04
1.00E-05
1.00E-06
1.00E-07
Cross Section (cm²/device)
0
10
20
30
Effective LET (MeV-cm2/mg)
Weibull fit curve for SEL testing of the DSP SMJ320F240
Sept 26-28, 2006
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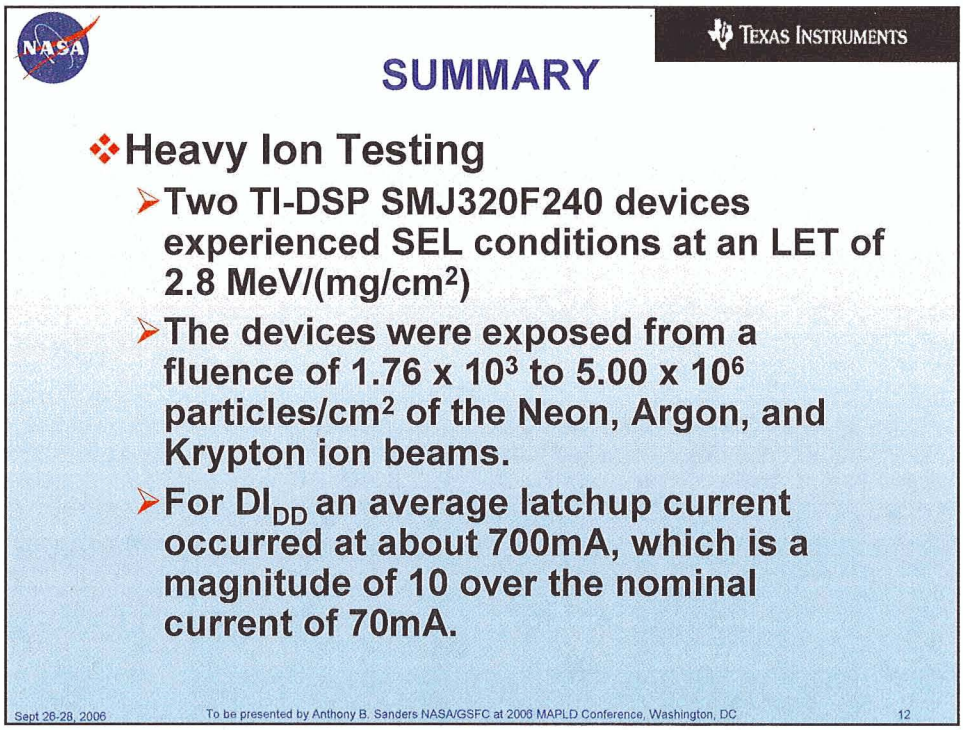
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SUMMARY
Heavy Ion Testing
Two TI-DSP SMJ320F240 devices experienced SEL conditions at an LET of 2.8 MeV/(mg/cm²)
The devices were exposed from a fluence of 1.76 x 10³ to 5.00 x 10⁶ particles/cm² of the Neon, Argon, and Krypton ion beams.
For DI$_{DD}$ an average latchup current occurred at about 700mA, which is a magnitude of 10 over the nominal current of 70mA.
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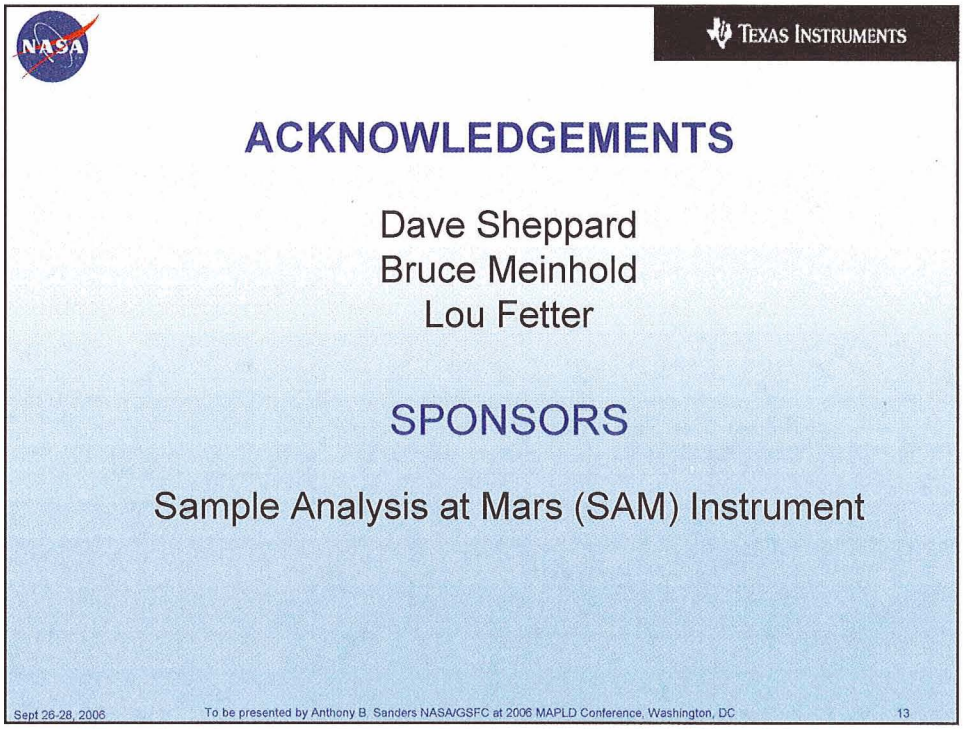
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ACKNOWLEDGEMENTS
Dave Sheppard
Bruce Meinhold
Lou Fetter
SPONSORS
Sample Analysis at Mars (SAM) Instrument
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